CMSC131
Lecture Set 1: Introduction

Topics in this set:

1. Course information
2. Tools needed for this course
3. Computer terminology basics

CMSC 131

- Name: "Object-Oriented Programming I"
- Instructor: Jan Plane
- TAs: Anusha, Shravya, Ferhan, Angela, Neha, Latha, Sam & Hyoungtae
- Class meetings
  - Lecture sections
    - 3 lecture sections
  - Lab sections
    - 7 lab sections
    - 8 teaching assistants
- Office Hours

What Is This Course?

- A *fast-paced* introduction to techniques for writing computer programs!
  - Skill Development in Programming
  - Conceptual Understanding of Programming
  - Not really "computer science"
- There will be quite a bit of work but assumes you are starting at level 0.
- Keys to success
  - Attend all classes and lab sections
  - Start assignments early – and continue until you truly understand
  - Get help early if you are having trouble – instructor & TAs
  - Study every day
    - it doesn't work to cram for these exams
    - ask questions as soon as you realize you are confused
  - *Check announcements on course web-page every day*

Textbooks & Course Web-Page

- http://www.cs.umd.edu/class/spring2009/cmsc131/
- Check daily!
- Review:
  - Announcements
  - Syllabus
  - Contact
  - Schedule
  - Lecture slides – outlines
  - Study questions – login: study password: daily

Course Software

- Eclipse
  - An IDE (integrated development environment)
  - You will use it for writing Java™ programs
  - Access to Eclipse (it's free!)
    - You can install it on your own machine: http://www.cs.umd.edu/eclipse
    - Also accessible in some Workstations at Maryland (WAM) labs around campus: http://www.wam.umd.edu/
- CVS (Concurrent Versions System)
  - A version-management system
  - You will use it for submitting your projects
  - We will talk more about this later

Tools for Writing Programs

- The old days
  - Text editor: used to create files of source code
  - Compiler: generate executables from source
  - Debugger: trace programs to locate errors
- Today: IDE = "integrated development environment"
  - Text editor / compiler / debugger rolled in one
  - Examples: Eclipse, Visual Studio, NetBeans, etc.

Basics of Eclipse

- http://www.cs.umd.edu/eclipse/EclipseTutorial/
- Eclipse is used to:
  - Create
  - Edit
  - Compile
  - Run
  - Debug

  programs (for this class, Java programs).

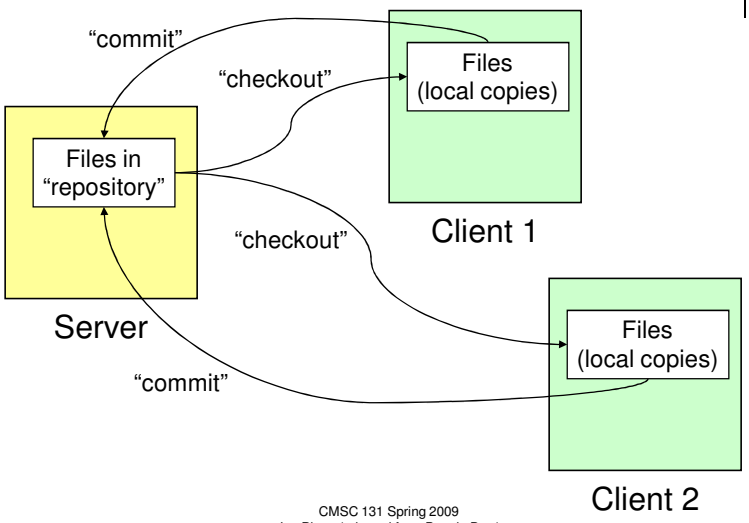
Basics of Eclipse-speak

- *Project*: collection of related source files
  - To create a program in Eclipse:
    - Create a new project
    - Create files in the project
- *Perspective*: framework for viewing and/or manipulating programs
  - Important perspectives in this class:
    - *Java*: for creating, running programs
    - *Debug:* for tracing, removing errors in programs
    - *CVS repository*: for interacting with assignment-submission system
- *Workspace: Where your files are stored locally*
- *Buffer: Window where editing takes place*
- *Demo*

Class Projects with CVS

- You will use Eclipse for Java programming in this course
- How will you:
  - obtain (check-out) files that are supplied to you
  - save (commit) the files for later work
  - turn in (submit) when you are finished
- *CVS (= Concurrent Versions System)*
  - Tool for project-file management
  - Maintains versions, etc.
  - Allows different sites to work on same project

CVS Worldview



CVS in More Detail

- CVS server maintains current versions of files in project (= “repository”)
- To access files from another machine (“client”), repository files must be “checked out”
- Changes to files on client may be “committed” to server, with changed files becoming new version
- (Once a repository is checked out by a client, subsequent versions may be accessed via “update”)

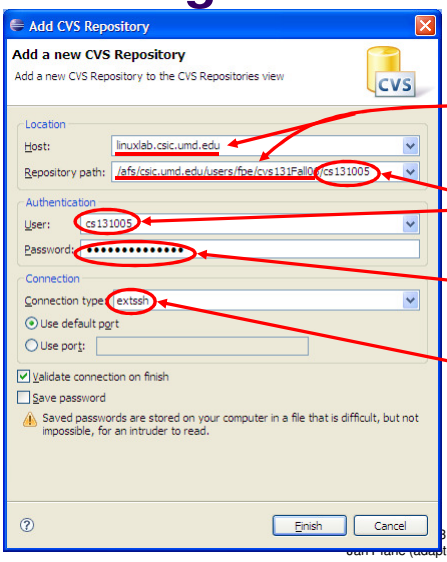
How CMSC Project Submission Works

- Repository created for each student linuxlab account
- You check out repository to start work on project
- When you “save” changes in Eclipse, “commit” automatically invoked by plug-ins
- You “submit” when finished using Eclipse (UMD plug-in handles relevant CVS commands)

Demo

1) Making a new Repository Location
2) Checking Out a project
3) Making changes to that project
4) Committing the project
5) Program execution
6) Submitting the project
7) Looking at the runtime results

Adding a CVS Repository



Common to everyone

Your linuxlab username

Your linuxlab password

Don't forget to set this!

Working on Project

- You do not have this project showing in the Java perspective.
- You go to the CVS perspective and check it out.
- When you switch back to “Java” perspective, your project is now there!
- Make sure you are in the Java perspective to edit
- When you save in “Java” perspective, changes are automatically committed to CVS repository.

Submitting the Project

- Edit the file
- Make sure it runs correctly
- Submit the project for grading
- Go to submit.cs.umd.edu to see test results
  - Public tests
  - Private tests
  - Release tests
    - give limited feedback (first two failed tests give more)
    - costs you “tokens” – usually 3 to start with
    - spent tokens regenerate in 24 hours

Computer Organization

- Hardware: physical parts of computer
  - Monitor, mouse, keyboard
  - Chips, boards
  - Cables, cards
  - etc.
- Software: non-physical (“logical”) parts of computer
  - Programs = instructions for computer to perform

Hardware Overview

- **CPU** = central processing unit
  - Executes the "instructions“ in programs
- **Main memory** = random-access memory = “RAM”
  - Stores data that CPU accesses, including instructions
  - FAST, but temporary; wiped out when computer is shut off!
- **Secondary memory**: Hard disks, CDs, DVDs, flash memory, etc.
  - Stores data that can be loaded into main memory
  - SLOWER, but permanent
- **I/O devices**
  - How you communicate with your machine
  - Keyboard, monitor, mouse, speakers, etc.
- **Networking equipment**
  - How others communicate with your machine
  - Networking “cards”, cables, etc.

Main Memory

- Computer data consists of off and on pieces (often written as 0's and 1's)
- bit: A single cell in main memory that can hold either a 0 or 1
- *byte*: A sequence of 8 bits
- word: Unit of memory (often a sequence of 4 bytes)
- Main memory: table of bytes indexed by "addresses"

Address	Byte value
1	1 0 0 1 1 1 0 1
2	0 0 0 1 1 0 0 1
3	1 1 1 1 1 1 0 1
4	1 1 0 0 0 1 0 0

How Many Different Values in a…

- Bit?

  2
- Two bits?

  4 = 2 x *2*
- Byte?

  256 = 2 x *2* x *2* x *2* x *2* x *2* x *2* x *2 =* 2^8
- Word?

  4,294,967,296 = 2^{32}

Other Standard Terminology

- 1 KB = 1 “kilobyte” = 2^{10} bytes = 1,024 bytes
- 1 MB = 1 “megabyte” = 2^{10} KB = 1,024 KB
- 1 GB = 1 “gigabyte” = 2^{10} MB = 1,024 MB

How Are Characters, Etc., Represented?

Via *encoding schemes*

Example: ASCII (American Standard Code for Information Interchange)

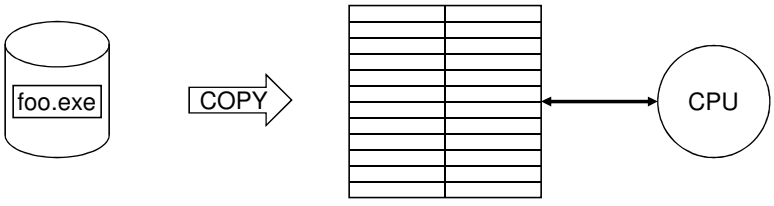
- Standard for encoding character values as bytes
- In ASCII:
  - ‘A’ 01000001
  - ‘a’ 01100001
  - ‘,’ 00101100
  - etc.

There are other character encoding schemes also: Shift-JIS, Unicode, etc.

Software Overview

1. **Operating system**: manages computer's resources; typically runs as soon as computer is turned on. Typical responsibilities:
   - *Process management*
     Determines when, how programs will run on CPU time
   - *Memory management*
     Controls access to main
   - *I/O, window system, network control*
     Performs low-level drawing, communication operations
   - *Security*
     Manages user IDs, passwords, file protections, etc.
2. **Applications**: programs users interact directly with; usually are explicitly run. Examples:
   - Word processors
   - Games
   - Spreadsheets
   - Music software,
   - Etc

How Programs Are Executed



Program "foo" initially stored in secondary storage

Program copied into main memory

CPU executes program instruction-by-instruction

Programming Languages

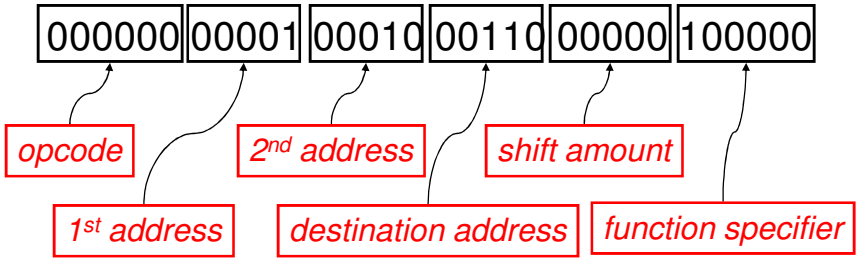
- Used to write programs that run on computers
- Generations of programming languages
  - 1st (1GL): machine code
  - 2nd (2GL): assembly code
  - 3rd (3GL): procedural languages
  - 4th (4GL): application-specific languages
  - 5th (5GL): constraint languages

1st Generation: Machine Code

- Recall: computer data is 0's and 1's.
- In machine code, so are programs!
  - Program: sequence of instructions
  - Machine code: instructions consist of 0's and 1's
- Next slide: example machine code instruction from MIPS (= "Microprocessor without interlocked pipeline stages") architecture
  - Popular in mid-, late 90s
  - Instructions are 4 bytes long

Example MIPS Instruction

- "Add data in addresses 1, 2, store result in address 6":
  00000000001000100011000000100000
- ???



Programming in 1GLs

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2nd Generation: Assembly

- Problem with 1GLs: Who can remember those opcodes, addresses, etc. as 0's, 1's?
- Solution (1950s): *assembly language*
  - Use *mnemonics* = descriptive character strings for opcodes
  - Let programmers give descriptive names to addresses
- MIPS example revisited:

  ```
  add $1, $2, $6
  ```

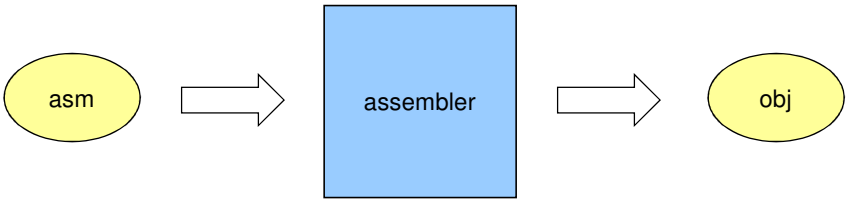
  instead of

  00000000001000100011000000100000

  for "add contents of addresses 1, 2, store result in 6"

Assemblers

- Computers still only work on machine code (1GL)
- Assembly language is not machine code
- *Assemblers* are programs that convert assembly language to machine code (= "object code")



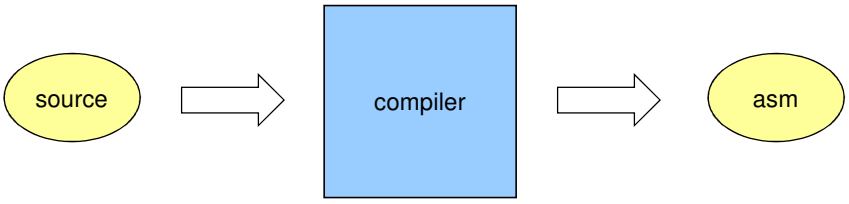
3rd Generation: Procedural Languages

- Problems with 2GLs
  - *Platform dependency*
    - Different kinds (*architectures*) of computers use different instruction formats

      E.g. x86, Pentium, 68K, MIPS, SPARC, etc.
    - 1GL / 2GL programs written for one kind of machine will not work on another
  - *Low level*: programs difficult to understand
- Solution (60s -- now): *procedural languages*
  - Higher-level, "universal" constructs
  - Examples: Cobol, Fortran, Algol, Pascal, C, C++, Java, C#

Compilers

- Computers can only execute machine code
- *Compilers* are programs for translating 3GL programs ("source code") into assembler / machine code



Interpreters

- Another way to execute 3GL programs
  - Interpreters take source code as input
  - Interpreters execute source directly
  - Much slower than compiled programs
- *Debuggers* are based on interpreters
  - Debuggers support step-by-step execution of source code
  - Internal behavior of program can be closely inspected

Object Oriented Terminology

- Procedural Languages
  - have procedures that can be reused
- Object Oriented Languages
  - centered on the objects
- object
  - principal entities that are manipulated by the program (nouns)
- class
  - a “blueprint” that defines the structure for one or more objects
- method
  - java term for a “function”, a “procedure” or a “subroutine”
  - this is the code that does something (verbs)
- main method
  - a special method that defines where program execution begins
- *statements*
  - individual instructions